Amendments to the Specification:

Applicant is submitting a substitute specification that includes paragraph numbering, and the amended paragraphs discussed below refer to the numbered paragraphs in the substitute specification.

Please replace paragraph **[0026]** with the following amended paragraph:

[0026] ~~Figures 8a-8e~~ Figures 8a-8d show various embodiments of the tip of the scanning probe microscope assembly of Figure 1;

Please replace paragraph **[0050]** with the following amended paragraph:

[0050] Probe 102 includes a base 128 coupled to the Z translator 112, a cantilever 130 integrally connected to the base 128, and a sharp projecting tip 132 integrally connected to the cantilever 130. The scanning control signals generated by the scanning control routine 122 control the XY and Z translators 110 and 112 so that tip 132 is positioned in close proximity to or in contact with the object 104 depending on what type of force interaction between the tip 132 and the object 104 is desired. As a result, the cantilever 130 will be deflected due to a non-optical interaction in the form of an atomic force interaction between the tip 132 and the object 104. As those skilled in the art know, this atomic force interaction may be due to Van der Waals forces, magnetic forces, electrostatic forces, lateral forces, or other related forces.

Please replace paragraph **[0064]** with the following amended paragraph:

[0064] Since tip 132 is coated with a conductive layer, a non-optical interaction in the form of a tunneling current is produced between the tip 132 and the object 104. The tunneling current in the object 104 is detected and measured by the tunneling current measurement circuit 158. In response, the tunneling current measurement circuit 158 outputs a tunneling current

measurement signal containing data representing the measured tunneling current. The measured tunneling current corresponds to the topography of the object.

Please replace paragraph **[0082]** with the following amended paragraph:

[0082] The camera 178 converts the focused infrared light into an infrared data signal containing data representing the focused infrared light. The data contained by the signal is analyzed and processed by the medium magnification optical microscopy analysis routine 141 to produce infrared image data representing a medium magnification (or microview) image of the topography of the object 104. The display routines 136 then formats the ~~visible~~ <u>infrared</u> image data, in the way described later, and the CPU 120 provides it to the display monitor 118 for display. The routine 141 is stored in the memory 124 and run on the CPU 120.

Please replace paragraph **[0122]** with the following amended paragraph:

[0122] First the wafer containing the probe 102 is placed in a vacuum <u>arc deposition</u> chamber containing carbon. A mask is placed over the probe 102 so that only the tip 132 and the area of the cantilever 130 around the base 178 of the tip 132 are exposed. At a pressure of approximately $1x10^{-7}$ to $1x10^{-11}$, the carbon is heated to a temperature of approximately 2100 to 3000 °C. The carbon condenses on the surface of the core material 300 or an overlying tungsten, silicon carbide or silicon nitride layer.

Please replace paragraph **[0130]** with the following amended paragraph:

[0130] In the case where the upper and lower bounds 502 and 504 are determined by the scanning control routine 122, the scanning control routine 122 controls the making of sample confocal microscopy measurements of the object 104 at low and high levels in the z direction.

To do so, the scanning control routine 122 generates control signals to control the translator 110 for positioning the object in the x,y plane and generates control signals to control the optics of the microscope 160 for adjusting the confocal region (focal plane) in the z direction. However, those skilled in the art will appreciate that a translator that ~~positions in~~ positions an object in each of the x,y, and z directions could also be used. The scanning control routine 122 then determines from the sample measurements the upper and lower bounds 502 and 504 (z2 and z1) of the object 104 and also the average diameter (n) of the smallest feature detected with the sample measurements.

Please replace paragraph **[0136]** with the following amended paragraph:

[0136] Once an area for inspection is located with the low magnification confocal microscopy scan, then the user issues with control terminal 116 a medium magnification zoom control signal for directing a medium magnification optical microscopy scan of the object 104 in this area. The scanning control routine 122 controls the XY translator 110 to position the tip 132 over the object 104 in the area specified by the zoom control signal and then ~~low~~ medium magnification optical microscopy measurements are made in this area in the way described earlier (block 202). This is done to find a smaller area to zoom in on for even closer inspection.

Please replace paragraph **[0148]** with the following amended paragraph:

[0148] If scanning control routine 122 determines that a junction of structures or a local change in structure is directly underneath tip 132, then it controls performance of a near-field spectrophotometric measurement, and/or a hardness testing measurement in the ways described earlier (block 218). The data produced by the analysis routines ~~143, 149, and 195~~ 143, 149, and 195 provides even more information or image data on local variations of composition at the current scan point and is recorded in the data base 198.

Please replace paragraph **[0150]** with the following amended paragraph:

[0150] If the current scan point is not the Mth scan point, then the scan is incremented to the next scan point and the above process is repeated until the Mth scan point is reached. However, if the current scan point is the Mth scan point, then the display routines 136 combine the data processed by the routines 137, 138, 151, 143, ~~149,~~ and 195 into a single high magnification image of the object in the way described later (block 220).

Please replace paragraphs **[0157]** to **[0163]** with the following amended paragraphs:

[0157] The display routines 136 first ~~obtains~~ obtain the zoom (i.e., magnification) level desired by the user (block 230). The user requests the zoom level with control terminal 116 which issues a zoom level command signal containing data representing the desired zoom level. This signal is received by the CPU 120 and the display routines 136 in response ~~obtains~~ obtain the desired zoom level.

[0158] The display routines 136 then ~~determines~~ determine the desired zoom level from the data contained in the received zoom level command signal (block 232).

[0159] If the desired zoom level is a low magnification zoom level, then display routines 136 ~~formats~~ format the visible optical image data provided by the visible optical microscopy analysis routine 139 (block 234). This formatted data is then provided to the display monitor for display of the represented image (block 236).

[0160] If the desired zoom level is a medium or high magnification zoom level, then display routines 136 first ~~obtains~~ obtain the hues of the low magnification visible optical image data provided by the visible optical microscopy analysis routine 139 (blocks 238 and 240).

[0161] In the case of a medium magnification zoom level, display routines 136 ~~uses~~ use the visible optical image hues to format the infrared optical image data provided by the optical microscopy analysis routine 141 so that it has a color pattern consistent with the visible optical image (block 242). The formatted data is then provided to the display monitor 118 for display of the represented image (block 244).

[0162] In the case of a high magnification zoom level, as was suggested earlier, display routines 136 ~~overlays and combines~~ overlays and combines the recorded image data representing the various measurements made during the high magnification scan into a single high magnification image of the object 104 using conventional data processing techniques (block 246). In this way, the data produced by the AFM or STM analysis routines 137 or 138 representing the primary high magnification measurements provides the basic image data. This basic image data is augmented with data produced by the near-field optical analysis routine 151 providing image data on deep surface features. It is also augmented with data produced by the STM or AFM analysis routines 138 or 137 representing the secondary high magnification measurements and providing image data on local variations in the composition or conductivity of object 104. Moreover, the basic image data is augmented with data produced by the spectrophotometric and hardness testing analysis routines 143, 149, and 195 providing further image data on local variations of the composition of object 104.

[0163] After the single high magnification image is produced by the display routines 136, ~~it uses~~ they use the visible optical image hues to format the single image so that it has a color pattern consistent with the visible optical image (block 248). Where the visible optical image color differences are smaller than the infrared optical image gray scale differences, intermediate hues are created by display routines 136 around the visible optical image hues using the visible optical image hues as the center for variation. The formatted data is then provided to the display monitor 118 for display of the represented image (block 250).

Please replace paragraphs **[0166]** to **[0168]** with the following amended paragraphs:

[0166] As shown in Figure 22, the display routines 136 include a display ~~formatter~~ formatting routine 520. The display ~~routine 136 first obtains~~ routines 136 first obtain the zoom (i.e., magnification) level and type of image desired by the user. The user requests the zoom level and image type with control terminal 116 which issues command signals indicating the desired zoom level and image type. This signal is received by the CPU 120 and provided to the display ~~formatter~~ formatting routine 520.

[0167] When the zoom level specifies the low magnification confocal microscopy mode or the medium magnification optical microscopy mode, the data ~~formatter~~ formatting routine 520 formats the data provided by the low magnification analysis routine 139 or the medium magnification analysis routine 141. Depending on the zoom level and type of image requested by the user with the control terminal 116, the data ~~formatter~~ formatting routine 520 formats the data for display as a 3D or 2D image of at least a portion of the object 104.

[0168] Similarly, when the zoom level specifies the high magnification microscopy mode, the data ~~formatter~~ formatting routine 520 overlays and combines the recorded image data representing the various measurements made during the high magnification scan into a single high magnification 3D or 2D image of at least a portion of the object 104 depending on the desired image type requested by the user. This is done using conventional data processing techniques, as suggested earlier. In this way, the data produced by the AFM or STM analysis routines 137 or 138 representing the primary high magnification measurements provides the basic image data. This basic image data is augmented with data produced by the near-field optical analysis routine 151 providing image data on deep surface features. It is also augmented with data produced by the STM or AFM analysis routines 138 or 137 representing the secondary high magnification measurements and providing image data on local variations in the composition or conductivity of object 104. Moreover, the basic image data is augmented with data produced by the spectrophotometric and hardness testing analysis routines 143 and 195 providing further image data on local variations of the composition of object 104.

Please replace paragraphs **[0170]** to **[0175]** with the following amended paragraphs:

[0170] Referring again to Figure 22, the display routines 136 include a color mapping (or assigning) tool routine 521. The program used to implement the color mapping tool 521 is listed in Appendix A. The user selects and operates the color mapping tool routine 521 by issuing appropriate commands with the terminal 116. Thus, the color mapping tool routine 521 is responsive to commands issued by the user with the terminal 116 such that the user can map a specific range of data elements to a specific range of colors.

[0171] Specifically, as shown in Figure 23a, when the user selects the color mapping tool routine 521, it generates a ~~color map~~ color mapping tool 523a of the image 522a of object 104 currently being displayed by the display 118. Although the image 522a shown in Figure 23a is a 2D image, those skilled in the art will recognize that the image of object 104 displayed by the display may also be a 3D image. The data representing the ~~color map~~ color mapping tool 523a is formatted by the data ~~formatter~~ formatting routine 520 for display and provided from the CPU 120 to the display 118 which then displays the ~~color map~~ color mapping tool 523a. The image 522a and the color map 523a may be displayed in window fashion such that they may be displayed simultaneously together or separately at the command of the user with the terminal 116.

[0172] The generated ~~color map~~ color mapping tool 523a includes a histogram 524a of the image data of the image 522a. The histogram 524a sorts all of the topographic data points of the image data by their heights in the z direction (i.e., z values). The vertical axis of the histogram 524a is a linear range of the z values bounded by the max and min values 525a. The horizontal axis indicates for each z value how many data points of the image data have that z value.

[0173] The ~~color map~~ color mapping tool 523a also includes a vertical color strip (or bar or pallette) 526a that identifies a range of colors. The ~~color map~~ color mapping tool 523a initially (in the default condition) maps each z value in the histogram 524a to a corresponding color in the color strip 526a over a predetermined range of colors in the color strip 526a. The ~~color map~~

color mapping tool routine 521 provides the color assignments to the data ~~formatter~~ formatting routine 520 which formats the image data for display of the image 522a with these color assignments.

[0174] As shown in figure 1, the terminal 116 includes a pointing device 117 such as a mouse, joy stick, track ball, or other multi-axis device. The ~~color map~~ color mapping tool 523a includes z value range identifying cursers 527a and color range identifying cursers 528a. The color mapping tool routine 521 is responsive to commands issued with the pointing device 117 such that a user can manipulate the cursers 526a and 527a with the pointing device 117 to identify a specific range of z values in the histogram 524a to be mapped to a specific range of colors in the color strip 526a. When the user selects the Remap button 527a of the ~~color map~~ color mapping tool 523a with the pointing device 117, the histogram 524a is updated with the new color assignments and the color tool 521 provides the new color assignments to the data ~~formatter~~ formatting routine 520 for formatting the image data to update the ~~image 300a~~ image 522a with the new color assignments. Thus, using the color mapping tool routine 521, the user may linearly map a large or small range of colors to a range of z values to visually amplify or de-amplify changes in z.

[0175] Although a conventional 24 bit display can display 16 million colors, the color strip 526a in Figure 23a may include only a specific range of these colors. Therefore, as shown in Figure 23b, in order to be able to select color ranges from the entire set of 16 million colors, the color mapping tool routine 521 may include a ~~color map~~ color mapping tool 523a 523b that has a base color strip 530 that identifies all 16 million colors. In addition, the ~~color map~~ color mapping tool 523a 523b includes a magnifying color strip 526b which is similar to the color strip 526a. The user then can manipulate the base color range identifying cursers 531 with the pointing device 117 to select a range of colors in the base color strip 530 which is magnified by the magnifying color strip 526b to show the various colors in the selected range. The user then manipulates the cursers 527b and 528b to map a specific range of the magnified colors to a specific range of z values in the same way as described earlier.

Please replace paragraphs **[0178]** to **[0200]** with the following amended paragraphs:

[0178] Turning to Figure 22 again, the display routines 136 also include a 3D surface measuring tool routine 532 which can be used when a 3D surface image of object 104 is displayed by the display 118. Such a 3D surface image 533 is shown in Figure 24 and produced when the user has selected the high magnification microscopy mode (i.e., AFM, STM, near-field optical, and hardness testing measurements). The user selects and operates the 3D measuring routine tool 532 by issuing appropriate commands with the terminal 116. The 3D measuring tool routine 532 is therefore responsive to commands issued by the user with the terminal 116 for making surface related measurements of the image 533.

[0179] Specifically, as shown in Figure 24, when the user selects the 3D surface measuring tool routine 532, it generates a cutting plane (or ruler) 534 formed by a rectangle projected on the image 533. Since the image 533 does not include interior imaged data points, the cutting plane 534 includes a single line 535 that delineates where the 3D surface image 533 is intersected by the cutting plane including the portions of the image 533 which are not visible. The data representing the image 533 and the cutting plane 534 is formatted by the data ~~formatter~~ formatting routine 520 and provided from the CPU 120 to the display 118 which then displays the cutting plane 534 so that it is projected on the image 533.

[0180] The 3D surface measuring tool routine 532 is responsive to commands issued with the pointing device 117 such that a user can select and manipulate the end points 536 of the cutting plane 534 to position the cutting plane with respect to the image 533. When selected, the end points 536 of the cutting plane 534 are circular magnifying cursers with crosshairs (similar to that shown in Figure 27) for accurate positioning of the end points 536 of the cutting plane 534. The magnification of the cursers is selectable by the user with the terminal 116. Thus, since the 3D surface measuring tool routine 532 slices and delineates the 3D surface image 533 in real time, it gives the user a very rapid method for probing any surface feature of the object 104.

[0181] After the cutting plane 534 is positioned by the user with the pointing device 117, the 3D surface measuring tool routine 532 generates cross section data corresponding to the cross section of the image 533 along the intersection of the cutting plane 534 and the image 533. Referring to Figure 25, the cross section data 537 is formatted for display by the data ~~formatter~~ formatting routine 520 and provided by the CPU 120 to the display 118 for display. The 3D surface image 533 and the cross section ~~data~~ information 537 may be displayed in window fashion such that they may be displayed simultaneously together or separately at the command of the user with the terminal 116.

[0182] The cross section ~~formatter~~ formatting routine 537 includes a 2D cross sectional image 538 along the intersection of the cutting plane 534 and the image 533. The cross section ~~formatter~~ formatting routine 537 includes the surface height difference 539 at the end points 536 of the cutting plane 534, the absolute length 540 of the cutting plane 534 in the x,y plane, and the length 541 of a line extending between the surface points of the cross sectional image 538 at the end points 536 in terms of the x,y,z coordinates.

[0183] Moreover, the cross sectional ~~data~~ information 537 includes cursers 542 and ~~543.~~ 543 to make absolute and relative measurements of the separation and angle of surface points intersection or interior points. The 3D surface measuring tool 533 is responsive to commands issued with the pointing device 117 such that a user can manipulate the cursers 542 to make absolute and relative measurements of the difference in z values, separation in the x,y plane, and angle between surface points of the image 538.

[0184] The 3D surface measuring tool routine 532 generates cross section cursor data ~~543~~ representing the measurements made with the cursers 542. The cross section cursor data ~~543~~ is formatted for display by the data ~~formatter~~ formatting routine 520 and provided by the CPU 120 to the display 118 for display of the cross section cursor information 543 including the measurements 548 made with the ~~cursers~~ ~~cursors~~ 542. The cross section cursor ~~data~~ information 543 may also be displayed in window fashion along with the 3D surface image 533 and the cross section ~~data~~ information 537.

[0185] Turning to Figure 22 again, the display routines 136 also include a 3D volume measuring tool routine 544 which can be used when a 3D volume image of object 104 is displayed by the display 118. Such a 3D volume image 545 is shown in Figure 26 and produced when the user has selected the low or medium magnification microscopy mode (i.e., confocal or infrared optical measurements). The 3D volume measuring tool routine 544 is similar to the 3D surface measuring tool routine 532 and, like it, the user selects and operates the 3D volume measuring tool routine 544 by issuing appropriate commands with the terminal 116 for making 3D volume related measurements of the image 545.

[0186] The cutting plane 546 of the 3D volume measuring tool routine 544 is positioned by the user with the pointing device 117 in the same way as with the 3D surface measuring tool 532. After the cutting plane 546 is positioned, the portion of the image 545 between the user's viewpoint and the cutting plane 546 is made transparent with only the silhouette of its surface visible to the user. Furthermore, after the cutting plane 546 is positioned, the 3D volume measuring tool routine 544 also generates cross section data corresponding to the cross section of the image 545 at the intersection of the cutting plane 546 and the image 545. However, in this case the cross section data includes information about interior data points of the cross section. Referring to Figure 27, the cross section data is formatted for display by the data ~~formatter~~ formatting routine 520 and provided by the CPU 120 to the display 118 for display as a 2D cross sectional image 547. The 3D volume image 545 and the 2D cross sectional image 547 may be displayed in window fashion such that they may be displayed simultaneously together or separately at the command of the user with the terminal 116.

[0187] As shown in Figure 22, the display routines 136 include a 2D measuring tool routine 548 which can be used on the 2D cross sectional image 547, as well as any other 2D image of object 104 displayed by the display 118. The user selects and operates the 2D ~~volume~~ measuring tool routine 548 by issuing appropriate commands with the terminal 116 for making 2D related measurements of the image 547

[0188] As shown in Figure 27, when the user selects the 2D measuring tool routine 548, it generates a flat ruler 549 formed by a rectangle projected on the image 547. The data

representing the image 547 and the ruler 549 is formatted by the data ~~formatter~~ formatting routine 520 and provided from the CPU 120 to the display 118 which then displays the ruler 549 so that it is projected on the image 547.

[0189] Similar to the cutting planes 534 and 546 of the 3D ~~measuring tools~~ measuring tool routines 532 and 544, the end points 550 of the ruler 549 are magnifying cursers with crosshairs when selected by the user with the pointing device 117. Thus, the ruler may be positioned in the same way as was described for the cutting planes 534 and 546. After the ruler 549 is positioned, the 2D measuring tool routine 548 generates cross section data corresponding to the cross section of the image 547 along the inner region 551 of the ruler 549. This cross section data is generated, displayed, and measured in the same manner as that described earlier for the cross section data 537 shown in Figure 25.

[0190] The display routines 136 also include a 2D angle measuring tool routine 552 for measuring angles between points of a 2D image. As shown in Figure 28, when the user selects the 2D ~~angle tool~~ angle measuring tool routine 552, it generates an angle ~~measurer~~ measuring tool 553 formed by two flat rulers (similar to ruler 549 described earlier) joined at one of the end points 554 and projected on the image 547. The data representing the image 547 and the angle ~~measurer~~ measuring tool 553 is formatted by the data ~~formatter~~ formatting routine 520 and provided from the CPU 120 to the display 118 which then displays the angle ~~measurer~~ measuring tool 553 so that it is projected on the image 547.

[0191] As with ~~the ruler~~ each ruler 549, the end ~~points 554~~ points 550 of the ruler 549 are magnifying cursers with crosshairs when selected by the user with the pointing device 117. Thus, the end points 554 may be positioned in the same way as was described for the end ~~points 554~~ points 550 of the ruler 549. After the end ~~points 554~~ points 550 are positioned, the 2D angle tool 552 generates angle data representing the angle formed between the inner regions of the two rulers of the angle measurer 553. The angle data may then be generated and displayed like the cursor data 543 of Figure 25. Those skilled in the art will appreciate that one of the rulers of the angle measurer 533 could be used as the ruler 549 of the 2D measuring tool 548.

[0192] The program used to implement the 3D surface measuring tool routine 532, the 3D volume measuring tool routine 544, the 2D measuring tool routine 548, and the 2D angle measuring tool routine 552 is listed in Appendix B.

[0193] The display routines 136 further include a Fast Fourier Transform (FFT) ~~tool~~ routine 560 for filtering a 3D image, such as image 533 or 545 shown in Figure 24 or 16. The program used to implement the FFT ~~tool~~ routine 560 is listed in Appendix C. The user selects and operates the FFT ~~tool~~ routine 560 by issuing appropriate commands with the terminal 116.

[0194] Referring to Figure 29, when the user selects the FFT ~~tool~~ routine 560, it generates a 2D FFT of the 3D image 561 currently being displayed by the display 118 and a 3D projection of the 2D FFT. The data representing the 2D FFT and the 3D projection are formatted by the data ~~formatter~~ formatting routine 520 and provided from the CPU 120 to the display 118 which then displays the 2D FFT as the 2D FFT image 562 shown in Figure 30 and the 3D projection as the 3D FFT image 563 as shown in Figure 31. The displayed FFT images 562 and 563 provide a mapping of the spatial frequency of the structural elements of the 3D image 561. The 3D image 561, the 2D FFT image 562, and the 3D FFT projection image 563 may be displayed in window fashion such that they may be displayed simultaneously together or separately at the command of the user with the terminal 116.

[0195] In the 3D FFT image 563, each FFT node of the 2D FFT is a peak whose height (in z) is directly related to its magnitude (or intensity). Thus, the 3D image 563 may then be colored using the color mapping tool routine 521 described earlier. In this way, low magnitudes are colored darker than greater magnitudes so as to establish a floor above which are the principle peaks (FFT nodes) of the original space domain image 561. The FFT ~~tool~~ routine 560 then makes an individual inverse transform of the data group representing each light colored peak region above the floor which are then all linearly summed together with a single inverse transform of the data group representing all the dark colored regions below the floor to form the 3D image 567 in Figure 33.

[0196] The FFT tool routine 560 generates data representing a control panel. The data is formatted by the data ~~formatter~~ formatting routine and the control panel 564 is displayed by the display 118 as shown in Figure 32. The user then uses the pointing device 117 to select particular peaks of the 3D FFT image 563 and then manipulate the control bar 565 to increase or decrease the magnitude of the selected peak and the control bar 566 to vary the phase of the selected peak. This permits the user to change the magnitude and phase of each peak using the on screen controls while seeing the change in the resulting image 567 when the inverse transform data group for the peak is changed in response. In modest performance computing platforms even very complex images can be examined by this means in real time (changing for the user as fast as he manipulates the controls).

[0197] Additionally, with the pointing device 117, the user can select or create regions (or masks) of the 2D FFT image 562 covering specific spatial frequencies so that structures of spatial frequency within the region can be selected for filtering or amplification by the user. The 2D FFT tool generates the data representing a region and the data ~~formatter~~ formatting routine 520 formats the data so that the ~~region 565~~ region 568 is projected on the 2D FFT image 562 by the display 118. The user then ~~uses~~ changes the inverse transform data group for the region by using the pointing device 117 to manipulate the control bar 565 of the control panel 564 to increase or decrease the magnitude of the spatial elements within the created region and the control bar 566 to vary the phase of the spatial elements within the created region. Thus, the user can create any shape or number of regions on the 2D FFT in which the magnitudes and phases can be varied continuously. In addition the 2D FFT is calibrated in spacial frequencies each of which are displayed next to the 2D FFT so that structures of specific frequency can be selected while all others are de-emphasized or eliminated.

[0198] Furthermore once created the regions 568 form ~~a separate FFT mask~~ separate FFT masks which can be stored and recalled in data base 198 by the user for reuse with other images in which the regions will automatically size themselves to conform to the spacial characteristics of the new image. That is the regions forming the mask carry the specific spacial frequency information they were formed with and scale according to the range of the image to which they

are applied. Thus if a region spanned 2 units square on a ten unit image it would scale down linearly for a 100 unit image and up linearly for a 5 unit image. Therefore these regions have a radial mirrored symmetry directly related to the mirror symmetry of the FFT.

[0199] Figure 34 shows a sequence of masks 705a, 706a, 709a, and 711a and images ~~704a through 712a~~ 704a, 707a, 708a, and 710a used to create a particular FFT image ~~result~~ 712a. Each mask is located next to its resultant image. The original image ~~Image~~ 704a has a null or no masking of the associated FFT 705a. In ~~addition~~ addition, the inverse 710a ~~(mask is 711a)~~ is recolored so that the resultant sum image 712a of the inverse images 707a, 708a, and 710a shows the ~~spacial~~ spatial components associated with the mask 711a in blue.

[0200] Figure 35 shows an ~~alternate~~ alternative way to create a multi-region mask on a 2D FFT display by using regions which are drawn with the draw tools in separate colors 714a-717a. Again each region may be selected and the ~~control 703a~~ control panel 564 used to vary the sum inverse image in the ~~users realtime~~ user's real time.

Please replace paragraph **[0236]** with the following amended paragraph:

[0236] Referring to Figure 13, in operation, an external light source 252 may be used to illuminate the region of the tip at the object 104 for spectrophotometric measurements made with the ~~photosensitive junction diode~~ photodiode. Alternatively, infrared light 185 may be provided to the tip 132 in the ways described for Figures 1 an 11. The light 185 is emitted by tip 132 to induce Raman, second harmonic radiation, florescence or other photoemissive modes at the surface of the object 104 beneath the tip 132. In either case, the optical energy detected by the photodiode is represented by a voltage across the metal contacts 304a and 304b of Figure 14 and is provided to the ~~photosensitive~~ photodiode measurement circuit 254 which measures the optical energy and provides the CPU 120 with a signal containing data representing the measured optical energy. This data is then analyzed and processed by the near-field spectrophotometry analysis

routine 143 in the same way as was discussed earlier for the data received from the photodetector 192.

Please replace paragraph **[0238]** with the following amended paragraph:

[0238] The photodiode tip 132 then detects the light and the photodiode ~~measure~~ <u>measurement</u> circuit 254 provides a data signal to the scanning control routine 122 indicating the intensity of the light. As a result, the position of the tip 132 in X and Y can be computed by the scanning control routine 122 from this data signal and therefore it can also control positioning of the tip 132 in X and Y in a feedback loop fashion.

Please replace paragraph **[0241]** with the following amended paragraph:

[0241] ~~Figures~~ <u>Figure</u> 15 shows another variation of tip 132 for the embodiments of Figures 1 and 11. In this case, a coating 310 of an emissive material, such as gallium nitride or gallium arsenide, or a non-linear frequency doubling <u>emissive</u> material, such as potassium niobate or lithium titanate, is coated over a small region of the core material 300 at the sharp end 188 of the tip 132. The coating 310 extends approximately a few Angstroms to 10's of Angstroms from the point of the sharp end 188 and has a thickness in the range of approximately .5 to 500 Angstroms.

Please replace paragraphs **[0251]** to **[0252]** with the following amended paragraphs:

[0251] As shown in ~~Figure 20a~~ <u>Figure 19a</u>, the core material 300 of the cantilever 130 near the base 178 of the tip 132 is first coated with a non-linear frequency doubling material 313 such as potassium niobate or lithium titanate. Then, the tip 132 is coated with an obdurate material or insulator 312 such as diamond, silicon carbide, or silicon dioxide. The portion of the coating 312

over the frequency doubling emissive material 313 is removed using conventional techniques and then a conductive layer 304 of aluminum, gold, tungsten, or some other conductor is formed over the frequency doubling emissive ~~material 310~~ material 313 and the coating 312. Similar to the tips 132 of Figures 8a-8d, the conductive coating 304 is removed or rubbed off from the sharp end 188 of the tip 132 to form an aperture near the sharp end 188.

[0252] As shown in ~~Figure 20b~~ Figure 19b, an elongated pyramid shaped trench (or similar reflecting structure) 268 is etched into the bottom of the base 128 to form a reflecting surface. This trench 268 directs the infrared light 273 into the cantilever 130 where it will be frequency doubled by the frequency doubling material 330. The frequency doubled light energy propagates through the tip 132 until it is emitted at the sharp end 188 of the tip 132.